

the criticism on Prof. Blasius' recent book on storms may be cited as an illustration, and a close adherence to its text, viz., storms practically considered.

LETTERS TO THE EDITOR

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Force

IN his valuable lecture on force at Glasgow, reported in NATURE, vol. xiv., p. 459, Prof. Tait did great service by insisting on the duty of precision and consistency in the use of this as of other scientific terms, and showed clearly how the word "force" may be used precisely and consistently. My reason for troubling you with this communication is that I am unable to identify this use of the word with Newton's, on the assumption that the English equivalent for Newton's *vis* is "force."

As the same difficulty has probably occurred to other readers of NATURE, I should be glad if Prof. Tait would kindly tell us through your columns what are the equivalents in English for the phrases (1) *vis*, (2) *vis insita*, (3) *vis impressa*, each of which is used in Newton's "Principia."

In the phrase *vis insita*—if *force* is the English for *vis*—is not a meaning of the word "force" implied which is wider than and inclusive of the meaning of *vis impressa*? P. T. MAIN

An Intra-Mercurial Planet

THE discussion as to the existence of a planet within the orbit of Mercury leads me to communicate an observation made many years ago, which I believe nothing but the existence of an unknown planet between us and the sun can explain. On Sunday, January 29, 1860, the sun rose in a fog in London, so that he could be steadily looked at as if through a dark glass. Soon after eight o'clock a perfectly round black object was seen by four persons, including myself, clearly defined upon the lower half, according to my recollection, of the sun's disc. It passed slowly across his face and made its egress at about half-past nine A.M. In apparent size it was equal to the representations I have seen of Mercury in transit. F. A. R. RUSSELL

Pembroke Lodge, Richmond Park, September 30

Brilliant Meteor

THE brilliant meteor of September 24 was well seen in the neighbourhood of Ipswich, and as the observation of it was difficult in the absence of stars, the following notes may be useful. It was first seen at 6h. 31m. 15s. L.M.T., and the train was visible as a luminous cloud until 6h. 47m. 3s. L.M.T. The course had a length of about 25°, which was described in three seconds, and made an angle of 80° with the horizon. By means of the train which it left behind, it was possible to fix the point of disappearance with considerable accuracy, namely: altitude, 14° 6'; azimuth reckoned from south towards east, 54° 16'. At this time Saturn was visible, having an altitude of 10° 56', azimuth 53° 15'.

For purposes of description the course may be divided into three portions, roughly equal. In the first portion the meteor had a uniform brightness somewhat greater than a first magnitude star, but during the second portion it rapidly increased to many times the brightness of Venus, and almost suddenly diminished to its former magnitude. In the third portion it again increased in brilliancy, considerably exceeding its former maximum, and was suddenly extinguished without bursting. This third portion only was marked by the train estimated about 6° long, with a scarcely perceptible breadth. During the sixteen minutes that the train was visible it drifted about 12° northwards, losing gradually its definite outline. Direction of wind, south-south-west.

The diameter of the disc was certainly not greater than 2', and the form was pear-shaped, though not very prolonged, leaving the observer with the idea that the peculiarity of form was merely due to the persistence of the impression on the retina. It is very difficult to estimate its maximum brightness accurately, as the heavens afford us no object with which to compare it. I have recently shown that Venus has only $\frac{1}{80}$ th part of the light of the full moon, and there is no other standard

of light with which to bridge over this gap. If the moon had only a diameter of 2', its intrinsic lustre would be 240 times greater than it is, and the intensity would probably be such as would cause the observer involuntarily to avert his eyes when seen suddenly, even in full twilight; still, I do not think the meteor had much less light than such an object would have. The glare was of the colour, and closely resembled, a very vivid flash of lightning, for which it was mistaken by many persons.

JOHN I. PLUMMER

Orwell Park Observatory, September 27

The Age of Palæolithic Man

IN the extremely interesting communication on this subject which Mr. Skertchley has made to NATURE, vol. xiv. p. 448, there are one or two points on which I should like to say a few words.

First, in approaching this subject and endeavouring to find out the whole truth let us in starting have nothing but the truth. A human bone, a fibula, was certainly found beneath glacial clay in the Victoria Cave at Settle, but so far *no implements* have turned up from that ancient horizon. This is a simple inadvertence which does not in any way affect the strength of Mr. Skertchley's position, but I am anxious to correct it and as it were strangle it at the birth lest cuckoo-like it should shoulder kindred but legitimate statements out into the cold.

Mr. Skertchley's remarkable discovery consists in the finding of palæolithic implements beneath the great chalky boulder clay of Mr. Searles V. Wood, jun., which is the so-called East Anglian upper boulder clay, and this, as Mr. Skertchley says, and as I believe Mr. Searles Wood holds, and with which I certainly agree, is probably as old as the Lancashire lower boulder clay or till. And this Lancashire till is undoubtedly of the same age as the till of Scotland, as all authorities admit. Moreover this till is generally admitted to be the product of the great ice-sheet of Scotland and the North of England. We are therefore landed at the conclusion that implements have been found in beds which are probably of earlier age than the Scottish ice-sheet, a conclusion in which I cannot but heartily concur. Mr. Skertchley does not state this directly, but I presume this is the legitimate inference to be drawn from his statements, and one which he would himself admit.

There can be no doubt that this is very strong and corroborative evidence of the general views so ably urged by my friend, Mr. James Geikie, that all palæolithic implements and the fauna associated with them are of inter-glacial age. It may seem captious after having been led to the battle by so able a general, and having driven the enemy so far [already, to grumble at his stopping short in the pursuit, yet such is the object of my present remarks. And I would wish to point out that there are heights, or rather depths, which may yet be advantageously scaled to the further discomfiture of the foe.

Mr. J. Geikie has not ventured to carry the age of the bulk of the palæolithic beds further back than the time immediately *succeeding* the great Scottish ice-sheet. He appears to regard the "great submergence" which followed this as the chief cause for the removal from certain areas of the remains of men and animals which peopled them in inter-glacial times. "The palæolithic gravels of the south-east of England . . . are contemporaneous with those ancient valley-gravels of Scotland which overlie the till and boulder-clay, and which are themselves partially rearranged and covered with marine deposits belonging to the time of the great submergence."¹ He certainly once "puts his hand to the (ice-) plough," "No doubt, however, portions . . . especially in the districts south of the Thames, may date back to the earlier warm periods of the glacial epoch, and thus be contemporaneous with the fresh-water beds in the Scottish till; while some may go back even to pre-glacial ages;" but he immediately "looks back" to the sea of the great submergence as the great destroyer of palæolithic records. "After the great ice-sheet shrank back and the till and boulder clay had been deposited, a land-surface existed, rivers flowed down the valleys, and plants and animals clothed and peopled the country. In Scotland the fluviatile deposits belonging to that period have been subjected to great denudation, but in one place at least they have yielded animal remains, frogs and water-rats. But if the country had never been submerged after the withdrawal of the ice from the low grounds, there is good reason to believe that the presence of the relics of palæolithic man and remains of the animals with

¹ "The Great Ice Age," pp. 482-g.

which he was associated would have occurred in the valley-gravels of Scotland, Ireland, and the northern and midland counties of England, just as in those of the south-east." Mr. Geikie makes a similar statement in his preface:—"A wide land-surface existed in the British area after the disappearance of the ice-sheet and before the period of great submergence;" and he cites the discovery of the human fibula under glacial clay in the Victoria Cave in confirmation.

It has always seemed to me that in discarding the power of the ice-sheet for that of the "great submergence" as an agent for the removal of all traces of an earlier fauna, Mr. Geikie, when attacking the tree of prejudice, has cast down his axe and taken up a whittle. Apart from the very doubtful extent and depth of the submergence, its destructive powers cannot for completeness be compared to that of the grinding of an ice-sheet. In a submergence, even if the beating of the surf destroyed all superficial deposits—a supposition which, if applied, a coast so abounding in land-locked and sheltered firths as Scotland partly submerged would present, is in the highest degree improbable—the rivers at least would carry down carcasses into secure resting-places and entomb them in estuary mud, and it would be most unlikely that no such relics should be preserved when the land rose again. But, on the other hand, it is difficult to believe that any organic remains could escape the grinding of an ice-sheet if continued through a long period.

In the Victoria Cave, at any rate, the surroundings are such that nothing but an ice-sheet could have sealed up with glacial clay the remains discovered by the Committee. The valley lies close by, but is 900 feet deeper, and no advance of a mere valley glacier in the supposed later increase of glacial conditions could have brought the boulders to that height. The form and situation of the hill near the top of which the cave lies is such, that no small ice-field could have formed on it and brought this glacial debris. The origin of the boulders, their position, the ice-scratches on the rocks hard by, all point to the time of greatest glaciation when the whole district probably was covered in with ice and snow of great thickness. And the agent which closed the cavern and concealed the animals within it must have been the same which swept the country clean of their remains all around further than the eye can reach.

To sum up, the direct evidences as yet found to support, by actual infraposition, the inter-glacial age of palæolithic man and of the fauna with which he is associated, are as follows:—

1. Victoria Cave, Settle:—A human fibula under glacial till, and associated with *Elephas antiquus*, *Rhinoceros leptorhinus*, *Hyæna*, *Hippopotamus*, &c.¹

2. At Wetzikon, Canton Zurich, a piece of lignite containing basket-work lying beneath glacial deposits, and associated with *Elephas antiquus* and *Rhinoceros leptorhinus*.²

3. Near Brandon, Suffolk, implements, with bones not yet determined, in brick-earth beneath the great chalky boulder-clay of East Anglia.

There is nothing in any of these instances to support the notion that this particular fauna lived subsequently to the age of the Scottish ice-sheet and immediately prior to a great submergence.

The Settle till is undoubtedly of the age of the ice-sheet. The Wetzikon lignite lies upon a glacial till beneath a river gravel, and upon that are huge angular erratic blocks, "clearly indicating the presence of a great glacier posterior in date to the organic remains."³

The Brandon implements are beneath the chalky boulder clay which Mr. Seales Wood, jun., believes to be the product of an ice-sheet, though partly deposited beneath the sea, a condition which is incompatible with the co-existence of a great submergence.

After, and in sole opposition to, such evidence, we can hardly contentedly take the existence of frog and water-rat as upholding the presence of palæolithic man and his congeners in times later than the great ice-sheet of Scotland. The Arctic mammals are, of course, out of court and cannot be taken as evidence, for it is highly probable that they returned with the retreat of the ice; but, so far, we have no evidence that this was the case with the more tropical animals.

My friend Mr. James Geikie will, I am sure, take these sug-

¹ "The Relation of Man to the Ice-sheet in the North of England," NATURE, vol. ix., p. 14, 1873; also "Settle Caves Exploration," Brit. Assoc. Reports for 1874 and 1875.

² Rüttimeyer; Archiv für Anthropologie, 1875; also NATURE, vol. xiii. p. 130.

³ Lyell; "Antiquity of Man," p. 368.

gestions in the friendly spirit in which they are offered. My chief reason for bringing them forward is that we hear that a new edition of his valuable work is in preparation, and it will be a loss to geology if this matter be not fully discussed by one who is so well able to handle the subject in all its bearings. Meanwhile, we are deeply indebted to him for progress already made, and also to my friend Mr. Skertchley for this important addition to the evidence and the perspicuous manner in which he has brought it before us.

R. H. TIDDEMAN

The Flame of Chloride of Sodium in a Common Coal Fire

SOME time ago a correspondent of NATURE (vol. xiii. p. 287) inquired for an explanation of the fact that while common salt (chloride of sodium) colours the flame of an ordinary spirit-lamp yellow, the same substance thrown upon a common coal fire gives rise to a blue flame. In the next number (p. 306) Dr. Schuster stated that the origin of the blue flame was still involved in mystery, and (if my memory is correct, for I have not the number at hand) that he and Prof. Schorlemmer had been engaged in an investigation of the same.

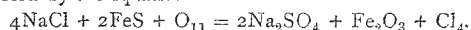
Dr. Schuster's letter shows that the question is not an unimportant one; and as I have lately made a few experiments which seem to confirm an explanation which occurred to me at the time, I send a short description of them.

The theory I put forward is that the blue flame noticed when salt is thrown upon a coal fire (of bituminous coal) is possibly due to the presence of carbonic oxide (CO), produced by a series of reactions, through which the common salt is converted into, first, sulphate, and then sulphide of sodium, as in the manufacture of crude carbonate of sodium (*black ash*), all the reactions being simply carried out in one furnace instead of two.

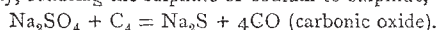
Leblanc's process consists in—1. Converting common salt into sulphate of sodium. 2. The "salt cake" is then mixed with coal and limestone, placed in a furnace and heated strongly, during which process a blue flame of carbonic oxide is observed to play upon the surface.

Now in the case we have under consideration, the only difference is that the salt is first converted into sulphate by the oxidation of the iron pyrites, from which no coal is free (and, in fact, it has been proposed to use such a process commercially, viz., by roasting common salt with iron pyrites).

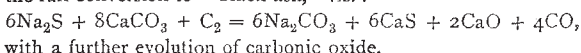
At this stage, then, the reaction going on in the fire will be expressed by the equation—



Almost simultaneously with this, the carbon of the coal comes into play, reducing the sulphate of sodium to sulphide, thus—



Of course were any substance present answering to the limestone used in practice, as may occur in the ash, we should have the full conversion to "black ash," viz.:—



with a further evolution of carbonic oxide.

I need not say that carbonic oxide burns with a violet blue flame perfectly indistinguishable from that produced by throwing salt into a bituminous coal fire. This may be proved at once by experimenting with a fire of anthracite, which itself only gives the slight lambent blue flame of carbonic oxide. The presence of salt makes no difference whatever in the colour of this flame, and it is difficult indeed to determine whether the salt is ignited at all. The difference in the two cases is just this:—A common coal fire has usually a large, bright, or smoky flame. Salt thrown on it diminishes its size and brightness by robbing it of free carbon or hydrocarbon—which gave it those qualities, and which is derived from the volatile matter—as in the reactions above set forth, the result being the production of carbonic oxide. In the case of anthracite, however, the free carbon is absent; but the carbonic oxide exists, and is equally apparent before and after the addition of salt. It is possible that the heat, instead of volatilising the sodium compounds and so giving the yellow flame, is expended in effecting the new chemical transformations.

In the case of a spirit-lamp or of a Bunsen burner there is no supply of carbon, nor is there any iron pyrites to be converted into sulphuric acid, consequently the above complicated process cannot take place, and the flame only shows the sodium coloration.

The following laboratory experiments were made with a view to test the accuracy of these speculations:—